INTERNATIONAL JOURNAL OF ELECTRICAL ENGINEERING & TECHNOLOGY (IJEET)

ISSN 0976 – 6545(Print)
ISSN 0976 – 6553(Online)
Volume 6, Issue 4, April (2015), pp. 01-08
© IAEME: www.iaeme.com/IJEET.asp
Journal Impact Factor (2015): 7.7385 (Calculated by GISI)
www.jifactor.com

IJEET

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DC HOME USING BATTERY -LESS PV HARVESTING SYSTEM WITH RTC BASED SOLAR TRACKING

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ABSTRACT

Present day energy generation and transmission is in the form of AC power. Due to the current energy crisis we are seeing a shift to renewable energy sources like the solar energy. Since the present appliances run on AC, we need to convert the available photovoltaic power which is in the form of DC into AC. If we use only DC appliances, then we could avoid the usage of multiple conversions. If the availability of solar ray is less, then the required additional energy will be taken from the grid and hence continuous supply of energy will be there. Moreover the real time based solar tracking ensures better capturing of available solar rays. This project finds its application in the institutions which functions at daytime and will be a relief to the present energy crisis.

Keywords: Battery less system, DC Home, Grid tied PV harvesting, RTC, Solar Tracking.

1. INTRODUCTION

The regeneration energy also called the green energy, has gained much importance nowadays. Green energy can be recycled, much like solar energy, water power, wind power, biomass energy, terrestrial heat, temperature difference of sea, sea waves, morning and evening tides, etc.. Among the non-conventional, renewable energy sources, solar energy affords great potential for conversion into electric power, able to ensure an important part of the electrical energy needs of the planet. The conversion principle of solar light into Electricity, called Photo-Voltaic (PV) conversion, is not very new, but the efficiency improvement of the PV conversion equipment is still one of top

priorities for many academic and/or industrial research groups all over the world. Among the proposed solutions for improving the efficiency of PV conversion, we can mention solar tracking. The topic proposed in this paper refers to a single axis solar tracker system that automatically adjusts the optimum PV panel position with respect to the sun by means of a servo motor using RTC. The purpose of this paper is to discuss DC distribution that has been widely applied in ships, traction systems, and communication networks however. DC may be better than AC under certain conditions, especially if the public grid is required to provide DC voltage. While comparing AC versus DC distribution within a building, the conclusion is that DC was superior if local DC generation is present.

In this paper we have shown that grid tied solar system can be developed by omitting the energy storage device like large capacity battery bank. It will not only reduce the internal losses for charging and discharging of battery bank but also at the same time a large amount of cost of the battery will be reduced. So, the system maintenance cost will be reduced also We have proposed a new approach to design a photovoltaic (PV) solar power system which can be operated by feeding the solar power to the grid along with the residential load. Again if there is an extra power demand for residential load along with the solar power then this system can also provide an opportunity to consume the power from the grid. The total system is controlled with the help of some the sensors and a micro controller. As a whole a significant reduction in the system costs and efficient system performance can be realized.

II. BATTERY LESS GRID TIED PV HARVESTING SYSTEM

A grid-connected photovoltaic power system, or grid-connected PV system is an electricity generating solar PV system that is connected to the utility grid. A grid-connected PV system consists of solar panels, one or several inverters, a power conditioning unit and grid connection equipment. They range from small residential and commercial rooftop systems to large utility-scale solar power stations. Solar systems that are connected to an existing electrical utility are called ‘grid-tied’ systems. Grid-tied systems do not have batteries for storing energy. Instead, during periods of excess solar electricity generation, the electric meter turns backwards. When electrical demands are greater than electricity generated by the solar array, the power grid supplies this demand. The customer only pays for electricity used (net metering=total power used- solar power generated).

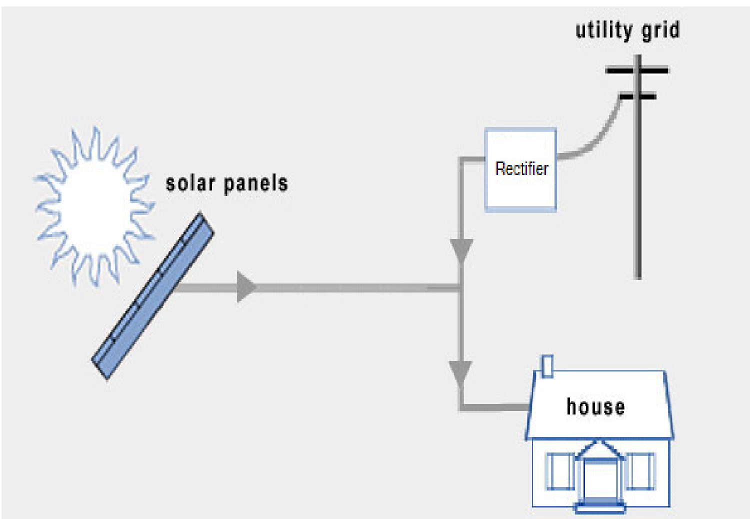

Fig. 1 diagram of planned grid-tied pv system

The simplicity of "Grid-Tied" solar is there are no batteries which have a limited life and require another intermediate piece of hardware, a charge controller to regulate them from being over charged. This makes Grid-tied the most inexpensive solar electrical option to install, costing as little as $7 per rated watt installed compared to battery based systems that cost more than $10 per watt. The Return on Investment would depend on the cost of electricity you are avoiding. Grid-Tied systems also have the advantage of higher rated efficiency at 91-95% as compared to about 80-85% efficiencies found with battery based systems. Probably the greatest draw back with grid-tied direct. At the same time supply from the grid which will be an ac will be rectified and fed to the dc appliances. As day by day the demand of electricity is increased and that much demand cannot be meeting up by the conventional power plants. And also these plants create pollution. If we look at the nature of load demand curve it is found that demand is increased from morning for different causes like opening the shops, markets, schools, colleges, offices etc. and that increased demand remains up to around 5 pm. And from the study of PV system it is found that, it is very much ideal to meet that increased energy demand by using Grid Connected Photovoltaic System. That's why we go for grid connected topology.

2.1 Proposed Tracking

For the maximum utilization of the solar energy the angle of incidence of the solar radiation on the solar panel must be 90^o. In order to make it 90^o the panel is turned along the direction of motion of the sun, this is called tracking. Here we are introducing a new method of tracking by combining the Maximum Power Point Tracking (MPPT) method and tracking based on time called Real time clock (RTC) based tracking.

2.1.1 MPPT Tracking

Maximum power point tracking (MPPT) is a technique that grid connected inverters, solar battery chargers and similar devices use to get the maximum possible power from one or more photovoltaic devices, typically solar panels though optical power transmission systems can benefit from similar technology. Maximum power point trackers may implement different algorithms and switch between them based on the operating conditions of the array.

Each solar cell has a point at which the current (I) and voltage (V) output from the cell result in the maximum power output of the cell. In the diagram below the curve is an example of the standard output expected from a solar cell, the Maximum Power Point is at the position marked on the diagram. In MPPT Tracking first by turning the panel from east to west and from west to east the position where maximum voltage is found and the panel position is fixed to that direction after finding that position the tracking is continued based on the time. The principle is that if the output from the cell can be regulated to the voltage and current levels needed to achieve a power output at this point, then the power generated by the solar cell will be used most efficiently. A Maximum Power Point Tracking solar regulator will simulate the load required by the solar panel to achieve the maximum power from the cell. The regulator will work out at which point the cell will output the maximum power and derive from this the voltage and current outputs required for maximum power to be achieved. It will then calculate the load that it must simulate based on these voltage and current levels $R=V/I$.

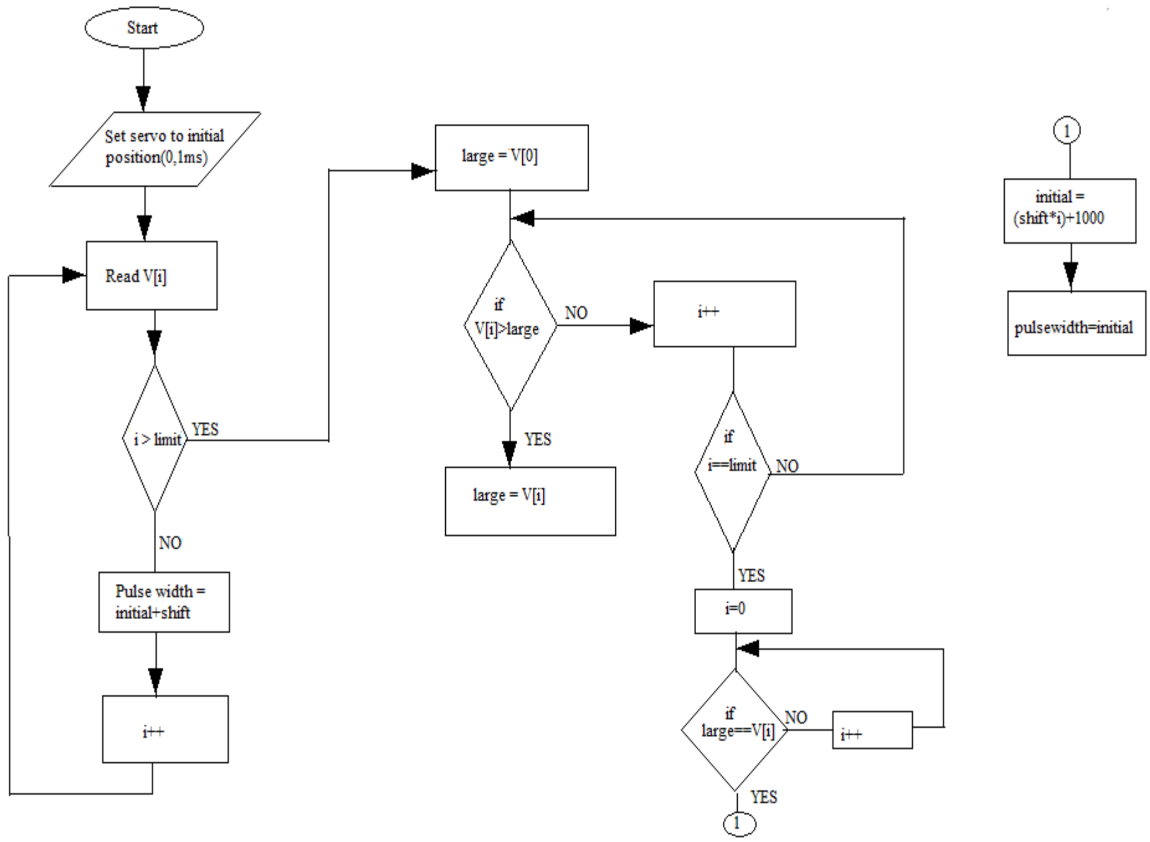

Fig.2 Flowchart of MPPT algorithm in this proposed system

2.1.2 RTC Based Tracking System

In RTC based tracking 8051 micro controller is used , instead of using RTC as a device we are creating our on RTC from the clock given to microcontroller this enable us to execute MPPT at the beginning of each day.

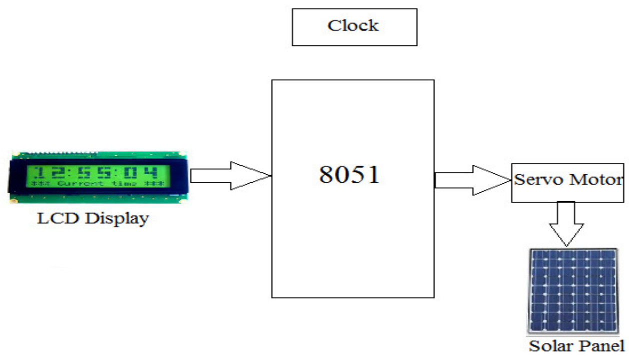

Fig.3 Block diagram of RTC based tracking system

The positional direction of the sun with respect to time has been measured and implemented as an algorithm in the controller. Then, the controller in the chip delivers an output, the corresponding PWM signals, to drive the servo motors. Thus, the directions of the single dimensional solar platform can be tuned to achieve optimal energy, respectively. In this mode the controller will continuously reads the Real Time Clock (RTC) and compares with the tabular values

stored, if it matches with those values the corresponding positional values will be send to the PWM generator which will make the motor to operate to rotate solar panel to words sun shine, By tuning the two-dimensional solar platform, the optimal efficiency of generating power will be achieved. The panel is connected to the servo motor and is controlled through the microcontroller. The output voltage of the panel will be read through the ADC channel of the controller. Initially the panel output voltage readings have been measured for a day by fixing the panel in a fixed direction, again tested by making panel rotatable according to the sun tracking using RTC.

When the time is entered, with the increase in clock by providing a delay of 1000ms and incrementing the seconds microcontroller creates a clock and the current time is compared with the tabular values stored, if it matches with those values the corresponding positional values will be send to the PWM generator which will make the motor to operate to rotate solar panel to words sun shine. By tuning the two-dimensional solar platform, the optimal efficiency of generating power will be achieved. The proposed system provides a variable indication of their relative angle to the sun by comparing with pre-defined measured readings. By using this method, the solar tracker was successfully maintained a solar array at a sufficiently perpendicular angle to the Sun. The power increase gained over a fixed horizontal array was in excess of 40%. The proposed design is achieved with low power consumption, high accuracy and low cost. The energy received from the Sun can be increased using the proposed solar tracking system during the time interval from 8.00AM to 5.00PM when compared with fixed solar cell system.

The proposed system provides a variable indication of their relative angle to the sun by comparing with pre-defined measured readings. By using this method, the solar tracker was successfully maintained a solar array at a sufficiently perpendicular angle to the Sun. The power increase gained over a fixed horizontal array was in excess of 40%. The proposed design is achieved with low power consumption, high accuracy and low cost. The power increase gained over a fixed horizontal array was in excess of 40%. The proposed design is achieved with low power consumption, high accuracy and low cost.

2.1.3 Advantages of the proposed tracking system

Compared to a fixed panel, a mobile PV panel driven by a solar tracker is kept under the best possible in solution for all positions of the Sun, as the light falls close to the geometric normal incidence angle. Automatic solar tracking systems (using light intensity sensing) may boost consistently the conversion efficiency of a PV panel, thus in this way deriving more energy from the sun. Solar tracking systems are used to continually orient photovoltaic panels towards the sun and can help maximize your investment in your PV system. They are beneficial as the sun's position in the sky will change gradually over the course of a day and over the seasons throughout the year. Advantages to using a tracker system like this will depend mainly on its placement in determining how well it will increase the effectiveness of the panels. They can be used most effectively in areas with low horizons and locations that are shade free from dawn to dusk each day. Throughout the year the tracking array will be able to utilize the wide open access to gain every available electron from the sun.

III. DC HOME

An increasing number of energy-efficient appliances operate on direct current (DC) internally, offering the potential to use DC power from renewable energy systems directly and avoiding the losses inherent in converting power to alternating current (AC) and back.

A convergence of factors are driving recent interest in using the direct current(DC) from solar electric systems in its DC form to power electricity loads in buildings, rather than converting it to alternating current (AC) first as is current practice. The new millennium has witnessed sustained and

rapid growth in the adoption of rooftop solar electric systems and increased interested in advanced solar technology, as concerns over climate change have intensified. Net-metered photovoltaic power systems, which have source, as are batteries, which are the dominant energy storage technology used with such systems. An increasing fraction of the most efficient electric appliances operate internally on DC .This suggests that energy savings could be obtained by directly coupling DC power sources with DC appliances, thus avoiding DC-AC-DC power conversions. Recent demonstrations with commercial data centers have shown that significant energy savings can be achieved with DC power distribution delivered directly to DC loads, rather than utilizing AC power.

An important factor that favors the use of DC is the growing number of electric appliances that operate internally on DC, and the fact that these new ‘DC-internal’ technologies tend to be more efficient than their AC counterparts. “DC-internal” appliances include communication technologies and all consumer electronics, such as computers ,telephones, televisions, compact fluorescent lighting with electronic ballast, light emitting diodes (LEDs), and efficient DC motors. Fluorescent and LED lighting uses one-fourth of the power or less than the traditional incandescent lighting it is replacing in the residential and commercial sectors. Brushless DC permanent magnet motors can save 5-15% of the energy used by traditional AC induction motors, and up to 30-50% in variable speed applications for pumping, ventilation, refrigeration, space cooling DC-motor3driven heat pump technologies for water and space hearting can also displace Conventional resistance heating with a savings of 50 % or more. Thus, three factors together suggest that DC-internal loads will continue to grow, and will probably grow rapidly: the intensified focus on energy efficiency due to climate change, the fact that new DC-internal technologies can be significantly more energy efficient than their conventional AC counterparts, and the fact that those technologies are capable of servicing virtually all building loads. DC system could be preferable to an AC system in applications with many electronic loads, because DC distribution provided higher power quality and lower harmonics.

IV. EXPERIMENTAL RESULTS

Solar output of PV panels in fixed and tracking mode is shown in table 1 and 2 respectively

TABLE I: Solar output of PV panel in tracking mode

S.NO	TIME	PANEL VOLTAGE (IN VOLTS)
1	8.00AM	**10.6**
2	9.00 AM	**10.9**
3	10.00 AM	**11.3**
4	11.00 AM	**11.8**
5	12.00 PM	**12.4**
6	1.00 PM	**12.1**
7	2.00 PM	**11.7**
8	3.00 PM	**11.2**
9	4.00 PM	**10.8**
10	5.00 PM	**10.5**
11	6.00 PM	**10.3**

TABLE II: Solar output of PV panel in fixed mode

S.NO	TIME	PANEL VOLTAGE (IN VOLTS)
1	8.00 AM	9.8
2	9.00 AM	10.3
3	10.00 AM	10.7
4	11.00 AM	10.9
5	12.00 PM	11.4
6	1.00 PM	11.1
7	2.00 PM	10.8
8	3.00 PM	10.4
9	4.00 PM	9.3
10	5.00 PM	6.5
11	6.00 PM	6.3

V. CONCLUSION

Electricity consumption worldwide is continuously on the rise due to the load requirements for the electrification of transportation, houses, offices, factories and many other facilities. This paper presents a possible solution for incorporation of renewable energy sources in the power system. As the DC house reduces the energy losses it will allow for a cheaper micro generation system than an AC voltage system. Therefore it can be used by governments in developing countries as a tool to increase the quality of life and prosperity of their citizens quicker than by waiting to build a centralized generation and distribution network. It has been shown that the sun tracking systems can collect maximum energy than a fixed panel system and high efficiency is achieved through this tracker, it can be said that the proposed sun tracking system is a feasible method of maximizing the light energy received from sun. This is an efficient tracking system for solar energy collection. The method implemented in this project is simple, easy to maintain and requires no technical attention for its operation. The solar module with tracking system as demonstrated in the analysis achieves about 21% efficiency improvement over the static solar module. Hence implementation of this technique in building solar systems will greatly improve utility satisfaction.

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